(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 February 2006 (09.02.2006)

PCT

(10) International Publication Number
WO 2006/014054 A1

(51) International Patent Classification[7]: B65D 65/46

(21) International Application Number:
PCT/KR2005/002441

(22) International Filing Date: 27 July 2005 (27.07.2005)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
20-2004-0022090 2 August 2004 (02.08.2004) KR

(71) Applicant (*for all designated States except US*): **YOUL CHON CHEMICAL CO., LTD.** [KR/KR]; #370-1, Sindaebang-dong, Dongjak-gu, Seoul 156-709 (KR).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **KIM, Young-Hee** [KR/KR], Woosung Apt. 5-505, Bono 3-dong, Sangrok-gu, Ansan-si, Kyeonggi-do 425-732 (KR). **KIM, Heon-Moo** [KR/KR]; Jugong Apt. 338-508, #552, Cheolsan-dong, Kwangmyeong-si, Kyeonggi-do 423-733 (KR). **LEE, Sung-Arn** [KR/KR]; Jugong Apt. 320-303, Wolpi-dong, Sangrok-gu, Ansan-si, Kyeonggi-do 425-787 (KR). **KIM, Kang-Soo** [KR/KR]; Jugong Greenvill A 908-503, #765, Gojan 1-dong, Danwon-gu, Ansan-si, Kyeonggi-do 425-798 (KR). **YOON, Sung Hwan** [KR/KR]; Seohae Apt. 203-204, Jeongwang 4-dong, Siheung-si, Kyeonggi-do 429-772 (KR).

(74) Agent: **KIM, Sun-young**; Korea Coal Center, 10th Floor, 80-6, Susong-Dong, Chongro-Ku, Seoul 110-727 (KR).

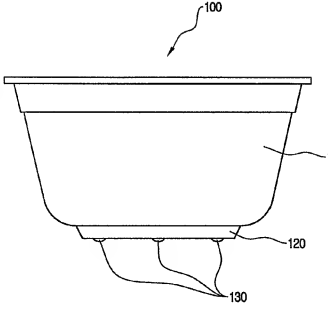
(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *with amended claims and statement*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: BIODEGRADABLE STARCH BOWL HAVING PROTRUSION ON BOTTOM PART OF THE BOWL



(57) Abstract: Disclosed is a biodegradable starch bowl being prepared so as to have a desired shape and having body part and bottom part, wherein protrusion is formed on sections of the bottom part. According to the present invention, there is no adhering phenomenon of the bottom part of the biodegradable starch bowl at the contact surface between the biodegradable starch bowl and a microwave oven when the biodegradable starch bowl is heated in the microwave oven, and also, the biodegradable starch bowl has improved sterilizing property, deodorizing property, long-term preservative property, releasing property, water-resistance and strength.

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【DESCRIPTION】

【Invention Title】

BIODEGRADABLE STARCH BOWL HAVING PROTRUSION ON BOTTOM PART OF THE BOWL

【Technical Field】

The present invention relates to a biodegradable starch bowl having protrusion on bottom part of the bowl. In particular, the present invention relates to a biodegradable starch bowl being excellent environmentally in which a bottom part of the bowl is not adhered during cooking in a heating body such as a microwave oven etc. and therefore its usability is improved.

【Background Art】

Developments for bowls containing instant foods are being performed actively due to the recent increase of the usage of instant foods.

In particular, in order to improve environmental pollutions due to disposable bowl made of foamable synthetic resin, plastics and aluminum foil, etc., there have been studies on biodegradable disposable bowl consisting of natural polymers such as paper and starch, etc. which can be decomposed after filled in ground.

Since the biodegradable disposable bowl is biodegradable contrary to such a disposable bowl made of synthetic resins etc., it does not have a problem of environmental pollutions and has an advantage of being easily processed.

When using the disposable bowl, there is often the case that the very disposable bowl containing foods such as noodles etc. is placed in a microwave oven and the like and heated for instant cooking.

Such a placing the conventional disposable bowls made of the materials such as PSP, papers, etc. in the microwave oven and performing cooking has the following problems. That is, in the case of the disposable bowl made of PSP, there occurs a phenomenon that the shape of the bowl changes or the bowl adheres to a contact surface with inner part of the microwave oven due to a secondary foaming phenomenon. Further, in the case of the disposable bowl made of paper, juice

contained in the disposable bowl comes to leak out due to the carbonization of the bottom part of the bowl.

On the other hand, in the case of the biodegradable starch bowl, there occurs a phenomenon that the bottom part of the biodegradable starch bowl adheres to the contact surface with the inner part of the microwave oven.

Such a phenomenon results from the evaporation of water, which the starch bowl contains, when cooking in the microwave oven. Particularly, the water in the body part of the starch bowl can be discharged to the outer space during the evaporation of the water. However, the evaporating water from the bottom part of the bowl cannot be discharged to the outer space due to the airtightness resulted from the continuous surface contact of the bottom part with the inner part of the microwave oven. Therefore, the water becomes dried after melting the starch in the bottom part and so the bottom part of the starch bowl is made to adhere to the contact surface with the inner part of the microwave oven during this course.

Fig. 1 is a schematic view showing the side surface of the conventional starch bowl. Fig. 2 is a schematic view showing the bottom part of the bowl in Fig. 1. Fig. 3 is a photograph showing that the adhering phenomenon of the bottom part occurs when performing the cooking in the microwave oven using the conventional starch bowl.

As shown in Fig. 1, a conventional bowl 10 made for containing foods like cup noodles is generally shaped to have a body part 11 and bottom part 12. Further, as shown in Fig. 2, there usually is a space 15 subsided into the body part 11 in the bottom part 12. The space 15 comes to be airtight because of the contact of the bottom part 12 besides the space 15 with the inner part of the microwave oven.

When the space becomes airtight and heated, the water contained in the starch bowl is made to evaporate and trapped in the airtight space. Then, the water, which is not discharged, is made to melt the starch of the bottom part of the starch bowl and then dried. To this end, as shown in Fig. 3, the bottom part of the starch bowl adheres

to the microwave oven.

Such an adhering phenomenon of the bottom part of the bowl makes the continuous performing of the cooking difficult and makes the juice therein leak out easily. Further, the adhering phenomenon causes a discomfort that adhered bottom part of the starch bowl should be peeled off from the microwave oven and problems that the bowl comes to look bad due to the transformation of the bowl and the handling of the bowl during eating becomes inconvenient.

Meanwhile, an inner or outer part of the biodegradable disposable bowl can be polluted with pathogenic Escherichia coli, O-157, pseudomonas aeruginosa, staphylococcus and salmonella, etc. In addition, since the biodegradable disposable bowl has a possibility of decomposition by microorganisms according to a keeping environment, it has a very weak preservative property. Also, the biodegradable disposable bowl has a poor impact-resistance compared to that of the prior plastic bowl.

Further, the biodegradable disposable bowl has a poor water-resistance and therefore there is such a problem that it is very easy for water to penetrate into the biodegradable disposable bowl.

Also, the biodegradable disposal bowl has low production efficiency due to its poor releasing property. That is, when preparing the biodegradable disposable bowl, the bowl is not easily released from a mold in case that a depth of the bowl is 5 cm or more. As a result, it is required to manually release the bowl one by one from the mold after discontinuing the preparing process, which has a problem of lowering the production efficiency.

Therefore, needed is a biodegradable starch bowl, which does not adhere at the contact surface with a heating body such as a microwave oven even when the biodegradable starch bowl is heated and further can assure improved sterilizing property, deodorizing property, preservative property, releasing property, water-resistance and strength.

【Disclosure】

【Technical Problem】

Accordingly, the present invention has been made to solve the above-mentioned problems. The object of the present invention is to provide a biodegradable starch bowl wherein good cooking properties that foods does not leak out or overflow can be accomplished and the transformation of the bowl as well as the discomfort of the handling of the bowl can be prevented by making a bottom part of a bowl not adhere to a contact surface with a heating body such as a microwave oven during cooking using the biodegradable starch bowl.

The other aspect of the object of the present invention is to provide a biodegradable starch bowl having improved sterilizing property, deodorizing property, preservative property, releasing property, water-resistance and strength in addition to the property that there does not exist such an adhering phenomenon of the bottom part of the bowl with the heating body during cooking as stated above.

【Technical Solution】

In order to accomplish the object, a biodegradable starch bowl according to the present invention is characterized by being prepared so as to have a desired shape and having body part and bottom part, wherein protrusion is formed on sections of the bottom part.

In the biodegradable starch bowl according to the present invention, the protrusion is characterized by having a shape of hemisphere; polygonal pillar; or cone.

In the biodegradable starch bowl according to the present invention, the height of the protrusion is characterized by being 0.2~3.0mm, the contact surface area of one protrusion with the ground being $30mm^2$ or less, and the number of the protrusion being 3 to 5.

In the biodegradable starch bowl according to the present invention, the biodegradable starch bowl is characterized by being a bowl prepared to have a desired shape by heating and pressurizing a composition for the biodegradable starch bowl comprising unmodified starch of 20~60 wt.%, pulp fiber powder of 5~30 wt.%, solvent

of 30~60 wt.%, photo catalyst of 0.1~2.0 wt.%, preservative of 0.01~1 wt.% and releasing agent of 0.5~5 wt.%, and a biodegradable film being attached to an inner surface of the bowl.

In the biodegradable starch bowl according to the present invention, the unmodified starch is characterized by being one or more selected from a group consisting of corn, potato, wheat, rice, tapioca and sweet potato.

In the biodegradable starch bowl according to the present invention, the pulp fiber powder is characterized by having a fiber length of 10 ~ 200 ㎛. Further, the pulp fiber powder is characterized by being made by crushing a broadleaf tree.

In the biodegradable starch bowl according to the present invention, the photo catalyst is characterized by being a titanium dioxide wherein an anatase content is 70% or more.

In the biodegradable starch bowl according to the present invention, the photo catalyst is characterized by being a titanium dioxide doped with one or more selected from a group consisting of Fe(III)(Fe^{3+}), vanadium (V), molybdenum (Mo), niobium (Nb) and platinum (Pt). Further, the photo catalyst is characterized by being a titanium dioxide doped with Fe(III)(Fe^{3+}).

In the biodegradable starch bowl according to the present invention, the photo catalyst is characterized by being a titanium dioxide added with one or more selected from a group consisting of silicon dioxide, vanadic pentoxide and tungsten oxide.

In the biodegradable starch bowl according to the present invention, the preservative is characterized by being one or more selected from a group consisting of sorbate, potassium sorbate, sodium benzoate and sodium propionate.

In the biodegradable starch bowl according to the present invention, the releasing agent is characterized by being one or more selected from a group consisting of monostearyl citrate and magnesium stearate. Further, the releasing agent is characterized by being a mixture of monostearyl citrate and magnesium stearate having the mixing ratio of 1:1.5 by weight.

In the biodegradable starch bowl according to the present invention, the solvent is characterized by being one or more selected from a group consisting of water, alcohol, alkaline aqueous solution and acidic aqueous solution. Further, the solvent is characterized by being water.

In the biodegradable starch bowl according to the present invention, the biodegradable film is characterized by being made of one or more selected from a group consisting of polylactic acid, polycaprolactone, polybutylene succinate, polyethylene succinate, polyvinyl alcohol, polyglycolic acid, ester starch and cellulose acetate.

In the biodegradable starch bowl according to the present invention, the thickness of the biodegradable film attached to the bowl is characterized by being 100~300㎛.

【Advantageous Effects】

According to the present invention, there is no adhering phenomenon of a bottom part of a biodegradable starch bowl even during cooking in a microwave oven. Further, the effect of improved sterilizing property, deodorizing property, preservative property, releasing property, water-resistance and strength is accomplished.

【Description of Drawings】

Fig. 1 is a schematic view showing a side of the conventional starch bowl.

Fig. 2 is a schematic view showing a bottom part of the bowl in Fig. 1.

Fig. 3 is a photograph showing that an adhering phenomenon of the bottom part of the bowl occurs when placing the conventional starch bowl in a microwave oven and heating it.

Fig. 4 is a schematic view showing a biodegradable starch bowl having protrusion on its bottom part according to an example of the invention.

Fig. 5 is a schematic view of the bottom part of the bowl in Fig. 4.

Fig. 6 is a photograph showing a mold for preparing a biodegradable starch bowl according to an example of the invention.

Fig. 7 is a photograph showing a mold cavity having air vent holes used according to an example of the invention.

Fig. 8 is a photograph showing the bowl of the invention positioned in the mold cavity having air vent holes according to the example of the invention.

Fig. 9 is a photograph showing a procedure of delivering a film to a heater section according to the example of the invention.

Fig. 10 is a photograph showing a procedure of heating the film so as to be softened according to the example of the invention.

Fig. 11 is a photograph showing a vacuum suction procedure according to the example of the invention.

Fig. 12 is a photograph showing a step wherein a vacuum suction is finished according to the example of the invention.

Fig. 13 is a photograph showing a procedure of cutting a film around the bowl according to the example of the invention.

Fig. 14 is a photograph showing a plane of biodegradable starch bowl according to the example of the invention.

Fig. 15 is a schematic view showing a bottom part of the bowl in Fig. 14.

Fig. 16 is a photograph magnifying protrusion of the bowl in Fig. 15.

Fig. 17 is a photograph showing a biodegradable starch bowl having protrusion on the bottom part thereof according to an example 1 of the invention.

Fig. 18 is a photograph showing a biodegradable starch bowl having protrusion on the bottom part thereof according to an example 2 of the invention.

Fig. 19 is a photograph showing a biodegradable starch bowl having protrusion on the bottom part thereof according to an example 3 of the invention.

Fig. 20 is a photograph showing a biodegradable starch bowl having protrusion on the bottom part thereof according to an comparative example 1 of the invention.

Fig. 21 is a photograph showing a biodegradable starch bowl having

protrusion on the bottom part thereof according to an comparative example 2 of the invention.

Fig. 22 is a schematic view showing an apparatus for measuring sterilizing and deodorizing effects according to the invention.

Fig. 23 is a photograph showing a bowl at an early stage of degradation according to the invention.

Fig. 24 is a photograph showing the bowl degraded after 20 days according to the invention.

Fig. 25 is a photograph showing the bowl degraded after 40 days according to the invention.

Fig. 26 is a photograph showing the bowl degraded after 100 days according to the invention.

【Mode for Invention】

Hereinafter, a biodegradable starch bowl having protrusion on a bottom part of the bowl according to invention will be described in detail.

In the present invention, bottom part is a constituent part of a bowl and means the constituent part of the bowl having a continuous horizontal surface and contacting with the surface onto which the bowl is to be placed or facing apart with the surface.

In the present invention, body part is a constituent part of a bowl and means the constituent part of the bowl supported by the bottom part.

In the present invention, protrusion means a protruded part formed on the bottom part in a body of the bowl or separately from the bowl.

In the present invention, hemisphere is used to mean a hemisphere including the case that it has a substantial shape of hemisphere even though a distance from the center is not the same as well as a hemisphere of its strict meaning wherein the distance from the center is the same.

At first, a biodegradable starch bowl according to the present invention is prepared to have a desired shape by heating and pressurizing a composition for the

biodegradable starch bowl. The bowl has a body part and a bottom part and protrusion is formed on sections of the bottom part.

Fig. 4 is a schematic view showing a side of the biodegradable starch bowl having protrusion on its bottom part according to an example of the invention. Fig. 5 is a schematic view of the bottom part of the bowl in Fig. 4.

As shown in Figs. 4 and 5, the biodegradable starch bowl 100 having protrusion on the bottom part of the bowl according to an example of the invention has a body part 110 and bottom part 120 and protrusion 130 is formed on a section of the bottom part 120. To this end, when placing the bowl in a microwave oven and heating it, water can be discharged from the bottom part 120 besides the protrusion 130 and the space 150 in the bottom part of the bowl.

That is, according to the invention, a contact surface area between the bowl and the microwave oven can be minimized and a space, from which water can be discharged, can be provided. Therefore, an evaporation of water can be induced smoothly and so the adhering phenomenon of the bottom part of the bowl can be prevented.

Herein, the protrusion can be made in a body of the bowl from the point of preparing the bowl and also can be formed by the method that separate protrusion is attached to the bottom part of the bowl after preparing the bowl through a molding. However, the method for making the protrusion in a body of the bowl is preferable in the viewpoint of the efficiency of the process.

The protrusion should have a contact surface area so as not to be attached to the microwave oven. Further, the preferable shape of the protrusion for preventing the adhering of the bowl to the microwave oven is a hemisphere that a shape of a ball is cut in two, a polygonal pillar or a cone. The preferable height, contact surface area and number of the protrusion for preventing the bowl to adhere the microwave oven are respectively 0.2~3.0mm in the height, 30mm^2 or less in the contact surface area of one protrusion with the ground (the surface of the heating body such as the microwave

oven to which the protrusion is attached) and 3 to 5 in the number of the protrusion having the height and the contact surface area.

Hereinafter, a method for preparing the biodegradable starch bowl having protrusion on the bottom part of the bowl according to the invention will be described in detail.

A composition for a biodegradable starch bowl is provided in advance for preparing the starch bowl.

In the present invention, the composition for a biodegradable starch bowl comprises starch, particularly unmodified starch, pulp fiber powder for reinforcing a tensile strength and a bend resistance, water as a solvent, a photo catalyst for sterilizing and deodorizing effect, a preservative for improving a preservative property and a releasing agent for increasing a releasing property.

Further, it is preferred that the composition comprises the unmodified starch of 20~60 wt.%, the pulp fiber powder of 5~30 wt.%, the solvent of 30~60 wt.%, the photo catalyst of 0.1~2.0 wt.%, the preservative of 0.01~1 wt.% and the releasing agent of 0.5~5 wt.%.

Specifically, anion natural starch, i.e., unmodified starch is used as the biodegradable starch. By using the unmodified starch, which is not physically and chemically processed, it becomes possible to relatively simplify a preparing process and to reduce a production cost.

It is possible to use corn, glutinous corn, potato, tapioca, sweet potato, rice, glutinous rice, wheat, barley, and other seeds, etc. having 40% or less of an amylose as the unmodified starch. In particular, it is preferred to use at least one selected from a group consisting of corn, potato, wheat, rice, tapioca and sweet potato.

It is preferred that the content of the unmodified starch is 20~60 wt.% based on a total composition. When the content is less than 20 wt.%, it is difficult to uniformly disperse the pulp and various additives due to the deficiency of starch serving as an organic binder. When the content is more than 60 wt.%, there exist

problems that the impact strength and water-resistance are deteriorated.

Next, the pulp fiber powder is included.

Since the unmodified starch typically has anion charges of 500 meq or more, there exists a tendency that the unmodified starch lumps together with each other. Accordingly, a bonding energy between the molecules becomes weak so that overall strength and water-resistance are decreased.

Therefore, in order to prevent such problems, used is a fine pulp fiber which is fine-powdered by crushing the pulp with a pulverizer. When using the fine pulp fiber, an apparent density can be increased. Further, a volume and a tendency to lump together can be decreased. To this end, it is possible to increase the overall strength such as a tensile strength and a bend resistance.

It is possible to use one or more selected from a group consisting of wood, straw, sugarcane, reed, bamboo, woody trunk, phloem fiber, leaf fiber and seedling fiber, as the pulp fiber.

Further, it is preferred to use the pulp fiber having a length of 10~200㎛ so as to increase a dispersibility of the fiber powders in the composition and to maintain a strength of the molded body to be constant according to parts of the molded body.

When a broadleaf tree, i.e., a long fiber and a needle-leaf tree, i.e., a short fiber are used among the pulp fibers, there is a difference between the amounts of distribution according to the lengths of the fibers to be crushed even in the case of using a screen having a same size.

Table 1 shows the distribution of the fiber lengths in the case of crushing the broadleaf tree through a screen having a hole of 0.35 mm (apparent volume density of the fiber: 30~50 g/ℓ).

【Table 1】

Fiber length (㎛)	Amount of distribution
less than 32	18%
32 ~ 50	11%

50 ~ 90	18%
90 ~ 150	28%
150 ~ 200	23%
more than 200	2%

Table 2 shows the distribution of the fiber lengths in the case of crushing the needle-leaf tree through a screen having a hole of 0.35 mm (apparent volume density of the fiber: 70~90 g/ℓ).

【Table 2】

Fiber length (㎛)	Amount of distribution
less than 32	12%
32 ~ 50	16%
50 ~ 90	29%
90 ~ 150	35%
150 ~ 200	6%
more than 200	2%

As can be seen from Tables 1 and 2, the reason that the lengths of the pulp fibers crushed are variously distributed is why the long fibers can be folded or twisted when passing through the holes (0.35 mm) of the screen. Although it is possible to regulate the distribution of the fiber lengths by adjusting a size of the screen hole, there are still diverse distributions even in the case of the regulation.

According to the invention, it is preferred to use the broadleaf tree pulp having a relatively excellent heat-resistance rather than the needle-leaf tree. If the pulp powders made by crushing the needle-leaf tree are used, they are carbonized due to the heat during a molding, thereby causing a color-change to a final product.

Next, it is desirable to use water as a solvent in an amount of 30~60 wt.%. Further, alcohol, alkaline aqueous solution and acidic aqueous solution as well as water can be used as the solvent.

Next, the photo catalyst is mixed for sterilizing or deodorizing effect. A

titanium dioxide doped with a metal such as an Fe(III)(Fe^{3+}), vanadium (V), molybdenum (Mo), niobium (Nb) and platinum (Pt), etc. may be used as the photo catalyst. Further, a titanium dioxide added with one or more of metal oxides such as silicon dioxide (SiO_2), vanadic pentoxide (V_2O_5) and tungsten oxide (WO_3), etc. may be used for the photo catalyst.

In particular, it is desirable to use a titanium dioxide wherein an anatase content is 70% or more, with a view point to increase the sterilizing and deodorizing effect.

Specifically, the titanium dioxide is classified into three types of rutile, anatase and vrookite according to crystal structure. The titanium dioxide wherein an anatase content is 70% means that titanium dioxide comprises an anatase crystal structure by 70% and the remaining 30% consists of a rutile-type titanium dioxide as a major element and a vrookite-type titanium dioxide as a very minor element. Since the anatase-type exhibits a high activity in a photo catalyst reaction, the titanium dioxide wherein an anatase content is 70% or more can provide sufficient sterilizing and deodorizing effect.

It is preferred that the photo catalyst is contained in an amount of 0.1~2.0 wt.%. When adding the photo catalyst beyond the range, the molding property and strength of the bowl may be lowered. When adding the photo catalyst too little, it is difficult to exhibit the sterilizing and deodorizing effects.

Next, it is preferred to use one or more selected from a group consisting of sorbate, potassium sorbate, sodium benzoate and sodium propionate in an amount of 0.01~1 wt.%, as the preservative.

Next, it is preferred to use one or more selected from a group consisting of monostearyl citrate and magnesium stearate in an amount of 0.5~5 wt.%, as the releasing agent.

Fig. 6 is a photograph showing a mold for preparing a biodegradable starch bowl according to an example of the invention.

A mold shown in Fig. 6 is for preparing a biodegradable starch bowl wherein its protrusion has a shape of hemisphere and a size of the protrusion is 5mm in lower part diameter x 1.0mm in height.

After introducing the composition for the biodegradable starch bowl as stated above into the mold, a biodegradable disposable starch bowl can be prepared by means heating and pressurizing the composition under 140~220℃ at a pressure of 0.5~8 kgf/cm^2 for 1~5 minutes.

Herein, in order to easily provide the prepared bowl with water-resistance during the preparing process, a biodegradable film is laminated to the bowl.

Fig. 7 is a photograph showing a mold cavity having air vent holes according to the invention. Fig. 8 is a photograph showing the prepared bowl being positioned in the mold cavity having air vent holes.

As stated above, after preparing the bowl in order that the bowl has protrusion, the prepared bowl is introduced to the mold cavity having air vent holes as shown in Figs 7 and 8.

Fig. 9 is a photograph showing a procedure of delivering a prepared biodegradable film to a heater section. Fig. 10 is a photograph showing a procedure of heating the film so as to be softened.

As shown in Figs 9 and 10, the biodegradable film is delivered to the heater section, which has been heated to 80~250℃ in advance, and then heated for 1~10 seconds so as to be softened.

Herein, especially, it is preferable to use one or more selected from a group consisting of polylactic acid, polycaprolactone, polybutylene succinate, polyethylene succinate, polyvinyl alcohol, polyglycolic acid, ester starch and cellulose acetate, etc. for the biodegradable film.

Further, it is preferred that a thickness of the film is 100~300㎛. When the thickness is below 100㎛, the content of the bowl may leak out because the film is thinly attached or torn. When the thickness is above 300㎛, this can increase the

production cost.

Fig. 11 is a photograph showing a vacuum suction procedure through air vent holes of the mold cavity. Fig. 12 is a photograph showing a step wherein a vacuum suction is finished.

As shown in Figs. 11 and 12, the softened film is positioned on an upper part of the bowl and then is vacuum-sucked with 150~600 mmHg vacuum for 0.5~10 seconds through the air vent holes of the mold cavity, so that it is closely attached to an inner surface of the bowl.

On the other hand, the film may be attached to the bowl by film lamination using a pressurized air injection rather than the vacuum suction.

That is, as described above, the bowl is positioned in the mold cavity having the air vent holes and the film is then delivered to the heater section, which has been heated to 80~250℃ in advance, and then heated for 1~10 seconds so as to be softened. Then, the softened film is positioned in the upper part of the bowl and then pressurized onto the bowl with the injection of air having 1~4 kgf/cm^2 of pressure for 0.2~3 seconds through an air injector from an exterior, so that it is closely attached to the inner surface of the bowl.

In addition, the film lamination using the vacuum suction and the pressurized air injection together is possible.

That is, as described above, the bowl is positioned in the mold cavity having the air vent holes and the film is then delivered to the heater section, which has been heated to 80~250℃ in advance, and then heated for 1~10 seconds so as to be softened. Then, the softened film is positioned in the upper part of the bowl, then pressurized onto the inner surface of the bowl with the injection of air having 1~4 kgf/cm^2 of pressure for 0.2~3 seconds through an air injector from an exterior, and simultaneously vacuum-sucked with 150~600 mmHg vacuum for 0.1~5 seconds through the air vent holes of the mold cavity, so that it is closely attached to the inner surface of the bowl.

According to the method of the film lamination using the vacuum suction and

the pressurized air injection together, it is possible to reduce a lamination time and to increase a production efficiency of the starch bowl and to enhance an attaching strength between the film and the bowl.

Fig. 13 is a photograph showing a procedure of cutting a film around the bowl. Fig. 14 is a photograph showing a plane of biodegradable starch bowl according to the invention. Fig. 15 is a schematic view showing a bottom part of the bowl in Fig. 14. Fig. 16 is a photograph magnifying protrusion of the bowl in Fig. 15.

As shown in Fig. 13, the film around a lip part of the bowl is cut. To this end, as shown in Figs. 14 to 16, obtained is a biodegradable starch bowl having protrusion on the bottom part thereof and the biodegradable film attached on the inner surface thereof, which is capable of improving water-resistance and reinforcing strength of the bowl.

The biodegradable starch bowl prepared as described above has no adhering phenomenon of the bottom part of the bowl even during cooking in the microwave oven. Therefore convenience in utilization of the bowl can be accomplished such that foods contained in the bowl does not leak out and overflow and also there is no discomfort of peeling from the microwave oven and the like.

Further, the biodegradable starch bowl according to the invention can be easily provided with water-resistance in a step after molding without an additional additive for improving the water-resistance by having the biodegradable film on inner surface of the bowl as described above. Also, since the film is attached on the inner surface of the bowl according to the biodegradable of the invention, it is possible to efficiently obtain water-resistance and further improve its preservative comparing to the case of the addition of the additive.

Furthermore, especially, there comes to exist such merits that the biodegradable starch bowl according to the invention is provided with the sterilizing and deodorizing property, and its preservative property is improved, and its releasing property is obtained when it is made of the composition for the biodegradable starch

bowl.

Fig. 23 is a photograph showing a bowl at an early stage of degradation according to the invention. Fig. 24 is a photograph showing the bowl degraded after 20 days according to the invention. Fig. 25 is a photograph showing the bowl degraded after 40 days according to the invention. Fig. 26 is a photograph showing the bowl degraded after 100 days according to the invention.

As shown in Figs 23 to 26, it comes to our knowledge that the biodegradable starch bowl according to the invention exhibited an excellent biodegradability after 100 days and especially there is no degradation in its biodegradability due to the attachment of the film since the film is biodegradable.

Hereinafter, the present invention will be described in detail by describing preferred examples and experiments using the examples. However, the present invention is not limited to the following examples

[Example 1]

- A composition for starch bowl –

Natural polymer (corn starch)	36.7%
Pulp fiber powder	9.9%
TiO_2 wherein an anatase content is 70% or more (or Fe^{3+}-doped TiO_2)	0.5%
Preservative (potassium sorbate)	0.2%
Releasing agent (Mg stearate)	0.8%
Releasing agent (Monostearyl citrate)	1.2%
Water	50.7%

A composition for molding was prepared by mixing the composition in a double-jacket heating agitator for 20 minutes.

The composition prepared was introduced to a mold having protrusion at its bottom part and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

Fig. 17 is a photograph showing a biodegradable starch bowl made of the

composition for molding, which has protrusion on the bottom part thereof. As shown in Fig. 17, prepared was a bowl-shaped molded body having protrusion in a hemisphere shape wherein the upper part of the hemisphere was cut and the hemisphere had a size of 7mm in lower part diameter x 0.9mm in height.

- A method for attaching a film to the bowl –

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl.

At first, a biodegradable film was delivered to a heater section, which had been heated to 200℃ in advance, and then heated so as to be softened. Then, the softened film was positioned on an upper part of the prepared bowl.

Then, the softened film was vacuum-sucked with 400mmHg vacuum for 10 seconds through the air vent holes of the mold cavity so that it was closely attached to an inner surface of the bowl.

In addition, the film was pressurized onto the inner surface of the bowl by injecting air having 4 kgf/cm^2 of pressure for 3 seconds through an air injector from an exterior so that it was closely attached to the inner surface of the bowl.

Then, the film around a lip part of the bowl was cut. Water of 100℃ was poured into the biodegradable starch bowl having the biodegradable film attached onto the inner surface thereof and the bowl was heated in a microwave oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Example 2]

The composition for molding a starch bowl in example 1 was introduced to a mold having protrusion at its bottom part and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

Fig. 18 is a photograph showing a biodegradable starch bowl having protrusion on the bottom part thereof according to the example 2. As shown in Fig. 18, prepared was a bowl-shaped molded body having protrusion in a hemisphere shape (a hemisphere wherein the upper part of the hemisphere was cut) of a size of 4mm in

lower part diameter x 0.4mm in height.

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl in the same manner with that of example 1.

Water of 100℃ was poured into the prepared bowl and the bowl was heated in a microwave oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Example 3]

The composition for molding a starch bowl in example 1 was introduced to a mold having protrusion at its bottom part and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

Fig. 19 is a photograph showing a biodegradable starch bowl having protrusion on the bottom part thereof according to the example 3. As shown in Fig. 19, prepared was a bowl-shaped molded body having protrusion in a rectangular pillar shape of a size of 10mm (width) x 3mm (length) x 1mm (height).

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl in the same manner with that of example 1.

Water of 100℃ was poured into the prepared bowl and the bowl was heated in a microwave oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Comparative example 1]

The composition for molding a starch bowl in example 1 was introduced to a mold having protrusion at its bottom part and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

Fig. 20 is a photograph showing a biodegradable starch bowl having protrusion on the bottom part thereof according to the comparative example 1. As shown in Fig. 20, prepared was a bowl-shaped molded body having protrusion in a circular pillar shape of a size of 15mm in diameter x 1.3mm in height and there was a cavity inside part of the protrusion.

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl in the same manner with that of example 1.

Water of 100℃ was poured into the prepared bowl and the bowl was heated in a microwave oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Comparative example 2]

The composition for molding a starch bowl in example 1 was introduced to a mold having a line shape protruded into the inside of the mold at a section of its bottom part and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

Fig. 21 is a photograph showing a biodegradable starch bowl wherein subsided line is formed on the bottom part thereof according to the comparative example 2. As shown in Fig. 21, prepared was a bowl-shaped molded body wherein 4 subsided lines were formed on the bottom part.

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl in the same manner with that of example 1.

Water of 100℃ was poured into the prepared bowl and the bowl was heated in a microwave oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Comparative example 3]

The composition for molding a starch bowl in example 1 was introduced to a mold not having a protrusion at its bottom part as the conventional form and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl in the same manner with that of example 1.

Water of 100℃ was poured into the prepared bowl and the bowl was heated in a microwave oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Comparative example 4]

The composition for molding a starch bowl in example 1 was introduced to a mold not having a protrusion at its bottom part as the conventional form and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl in the same manner with that of example 1.

Paper was put on a section of the bottom part of the prepared bowl. Water of 100℃ was poured into the prepared bowl and the bowl was heated in a microwave oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Comparative example 5]

The composition for molding a starch bowl in example 1 was introduced to a mold not having a protrusion at its bottom part as the conventional form and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl in the same manner with that of example 1.

Releasing agent was coated on the bottom part of the prepared bowl. Water of 100℃ was poured into the prepared bowl and the bowl was heated in a microwave oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Comparative example 6]

The composition for molding a starch bowl in example 1 was introduced to a mold not having a protrusion at its bottom part as the conventional form and then heated and pressurized under conditions of 180℃ and 3 kgf/cm^2 for 150 seconds.

A biodegradable film having a thickness of 100~300㎛ was attached to an inner surface of the prepared bowl in the same manner with that of example 1.

A film was attached on the bottom part of the prepared bowl. Water of 100℃ was poured into the prepared bowl and the bowl was heated in a microwave

oven for 7 minutes. Then, an adhering phenomenon to the microwave oven was observed.

[Experiment 1 – Evaluation of Adhering]

Table 1 shows the result of observing an adhering phenomenon to a microwave oven when 100 samples of starch bowls in the respective examples and comparative examples, which were made by molding the composition of the example 1, were prepared and placed in the microwave oven and then heated.

【Table 3】

	Example 1	Example 2	Example 3	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6
Number of adhering of the bottom part of the bowl to the ground of the microwave oven	0	0	0	19	13	100	79	61	87
Phenomenon of adhering to the ground of the microwave oven	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes

- Evaluation method : Evaluated was whether the adhering phenomenon of the bottom part of the bowl to the ground of the microwave oven occurred or not when the bowl was taken out from the microwave oven after the prepared bowl was placed in the microwave oven for 7 minutes and then heated.

- Evaluation method for phenomenon of adhering : When the bowl was taken out from the microwave oven

"No": This means that the bowl was peeled off clearly form the ground of the microwave oven.

"Yes": This means that a section of the bottom part of the bowl was not peeled off clearly at once due to its adhering to the ground of the microwave oven.

As shown in Table 3, it came to our knowledge that there was no adhering phenomenon of the bottom part of the bowl even when the bowl was heated in the microwave oven in the case of the biodegradable starch bowl, which is characterized by having protrusion of a hemisphere shape or rectangular pillar shape on a section of the bottom part of the bowl.

[Experiment 2 – Evaluation of physical properties of the bowl]

Evaluation of physical properties of the bowl made of the composition of example 1 was performed as follows.

At first, in the following results of a molding property, ◎ indicates that a surface of the body is smooth and has no wrinkles or pinholes. ○ indicates that a surface of the body is relatively rough but has no wrinkles or pinholes. × indicates that a surface of the body has wrinkles or pinholes and molding is difficult.

Regarding a compressive strength, measured was strength at the time of fracture of the bowl in case that both surfaces of the bowl were compressed using a load cell at a speed of 2 mm/s. In the following results, ◎ indicates above 5 $kg \cdot m/s^2$, ○ indicates 3~5 $kg\ m/s^2$, and × indicates below 3 $kg \cdot m/s^2$.

Regarding a stench, ten (10) researchers checked whether there occurred a nasty smell from the bowl besides a peculiar smell of the starch. In the following results, N indicates 'there exists no stench' and Y indicates 'there exists stench'.

With regard to a color change, a color of the bowl was compared with that of a standard composition (corn starch 36.7%, fiber powder 9.9% and water 53.4%).

Regarding a sterilizing effect, a UV lamp was positioned in a reactor as shown in Fig. 22 and surrounded by a quartz tube. A sample of molded body of starch having a size of 50 mm ×80 mm was put in the quartz tube and then Escherichia coli was made to pass through the tubes.

After that, light was irradiated with a 100W UV lamp having a wavelength of 360 nm and then a removal rate of Escherichia coli was measured in the reactor after

one hour.

Regarding a deodorizing effect, a UV lamp was positioned in a reactor as shown in Fig. 22 and surrounded by a quartz tube. A sample of molded body of starch having a size of 50 mm ×80 mm was put in the quartz tube and then was made to pass through acetaldehyde having a concentration of 600 ppm diluted with air.

After that, light was irradiated with a 100W UV lamp having a wavelength of 360 nm and then a decomposition efficiency of the acetaldehyde was measured in the reactor after one hour.

With regard to a long-term preservative property, the molded bodies prepared according to the example 1 were put in a thermohydrostat having conditions of 30℃ and a relative humidity of 90%, and it was examined how much the bowl was contaminated with fungi. In the following results, × indicates that fungi occurred in 20 days, ○ indicates that fungi occurred in 21~30 days, and ◎ indicates that fungi occurred in 31~90 days.

Regarding a releasing property, measured was the number of bowls which were attached to an upper mold and raised according to the elevation of the upper mold while not dropped onto a lower mold, when preparing 100 bowls of the example 1. Tables 4 shows that the less the number, the better the releasing property.

Table 4 shows the result of measurement of the molding property, the compressive strength, the stench, the color change, the sterilizing and deodorizing effect, the preservative and releasing properties in the bowl of example 1.

【Table 4】

Example	Molding property	Compressive strength	Stench	Color change	Sterilizing effect (removal rate of Escherichia coli)	Deodorizing effect (decomposition rate of acetaldehyde)	Preservative property	Releasing property (number)
1	◎	◎	N	N	100%	100%	◎	0

As can be seen from Table 4, it could be seen that the sterilizing and deodorizing effects were excellent in the bowl made of the composition of the example

1 especially in which TiO_2 wherein an anatase content is 70% or more was used as a photo catalyst. However, if such an expensive photo catalyst is added in an amount of 1 wt.% or more, the increase of the cost of the composition can be caused.

Further, it comes to our knowledge that stench and color change were prevented and fungi was inhibited excellently when potassium sorbate as the preservative was added in an amount of 0.2 wt.%.

[Experiment 3 - test of water-resistance]

In this experiment 3, measured was a water-resistance of a bowl having a biodegradable film especially made of polylactic acid among the bowls prepared as described above in order to evaluate water-resistances of the prepared bowl.

The biodegradable film was prepared as follows.

A film was prepared with a casting method using polylactic acid (PLA, glass transition temperature: 59℃, melting point: 175℃, flow index: 3.0 g/ 10 min.), which is a biodegradable resin. In general, the polylactic acid (PLA) is transparent and biodegradable and has a high strength and properties similar to those of polyester.

For measuring water-resistance, a liquid for testing water-leakage (surfactant: 0.3%, blue ink: 0.1%, and water: 99.6%) was poured into the starch bowl (depth: 70 mm, capacity: 450 cc) and then it was checked for 30 minutes whether there occurred any water-leakage.

That is, it was checked for 30 minutes with naked eyes whether the blue liquid for testing water-leakage was leaked out at any outer parts of the bowl.

As a result of the experiment, it could be seen that there was no water-leakage when using the film having a thickness of 100~300㎛.

【Industrial Applicability】

The present invention relates to a biodegradable starch bowl being excellent environmentally in which a bottom part of the bowl is not adhered during cooking in a heating body such as a microwave oven etc. and therefore its usability is improved.

【CLAIMS】

【Claim 1】

A biodegradable starch bowl being prepared so as to have a desired shape and having body part and bottom part, wherein protrusion is formed on sections of the bottom part.

【Claim 2】

The biodegradable starch bowl according to claim 1, wherein the protrusion has a shape of hemisphere; polygonal pillar; or cone.

【Claim 3】

The biodegradable starch bowl according to claim 2, wherein the height of the protrusion is 0.2~3.0mm, the contact surface area of one protrusion with the ground is $30mm^2$ or less, and the number of the protrusion is 3 to 5.

【Claim 4】

The biodegradable starch bowl according to claim 1, wherein the biodegradable starch bowl is a bowl prepared to have a desired shape by heating and pressurizing a composition for the biodegradable starch bowl comprising unmodified starch of 20~60 wt.%, pulp fiber powder of 5~30 wt.%, solvent of 30~60 wt.%, photo catalyst of 0.1~2.0 wt.%, preservative of 0.01~1 wt.% and releasing agent of 0.5~5 wt.%, and a biodegradable film is attached to an inner surface of the bowl.

【Claim 5】

The biodegradable starch bowl according to claim 4, wherein the unmodified starch is one or more selected from a group consisting of corn, potato, wheat, rice, tapioca and sweet potato.

【Claim 6】

The biodegradable starch bowl according to claim 4, wherein the pulp fiber powder has a fiber length of 10 ~ 200 ㎛.

【Claim 7】

The biodegradable starch bowl according to claim 6, wherein the pulp fiber

powder is made by crushing a broadleaf tree.

【Claim 8】

The biodegradable starch bowl according to claim 4, wherein the photo catalyst is a titanium dioxide in which an anatase content is 70% or more.

【Claim 9】

The biodegradable starch bowl according to claim 4, wherein the photo catalyst is a titanium dioxide doped with one or more selected from a group consisting of Fe(III)(Fe^{3+}), vanadium (V), molybdenum (Mo), niobium (Nb) and platinum (Pt).

【Claim 10】

The biodegradable starch bowl according to claim 4, wherein the photo catalyst is a titanium dioxide added with one or more selected from a group consisting of silicon dioxide, vanadic pentoxide and tungsten oxide.

【Claim 11】

The biodegradable starch bowl according to claim 4, wherein the preservative is one or more selected from a group consisting of sorbate, potassium sorbate, sodium benzoate and sodium propionate.

【Claim 12】

The biodegradable starch bowl according to claim 4, wherein the releasing agent is one or more selected from a group consisting of monostearyl citrate and magnesium stearate.

【Claim 13】

The biodegradable starch bowl according to claim 4, wherein the releasing agent is a mixture of monostearyl citrate and magnesium stearate having the mixing ratio of 1:1.5 by weight.

【Claim 14】

The biodegradable starch bowl according to claim 4, wherein the solvent is one or more selected from a group consisting of water, alcohol, alkaline aqueous solution and acidic aqueous solution.

【Claim 15】

The biodegradable starch bowl according to claim 4, wherein the biodegradable film is made of one or more selected from a group consisting of polylactic acid, polycaprolactone, polybutylene succinate, polyethylene succinate, polyvinyl alcohol, polyglycolic acid, ester starch and cellulose acetate.

【Claim 16】

The biodegradable starch bowl according to claim 15, wherein the thickness of the biodegradable film attached to the bowl is 100~300㎛.

AMENDED CLAIMS
[received by the International Bureau on 26 December 2005 (26.12.2005); original claims 2-16 unchanged, claim 1 amended]

【Claim 1】 **(Underlined part indicates the amended part)**

A biodegradable starch bowl being prepared so as to have a desired shape and having body part and bottom part, wherein protrusion is formed on sections of the bottom part **in order for water evaporated from the biodegradable starch bowl to be discharged easily during cooking in a heating body.**

【Claim 2】

The biodegradable starch bowl according to claim 1, wherein the protrusion has a shape of hemisphere; polygonal pillar; or cone.

【Claim 3】

The biodegradable starch bowl according to claim 2, wherein the height of the protrusion is 0.2~3.0mm, the contact surface area of one protrusion with the ground is $30mm^2$ or less, and the number of the protrusion is 3 to 5.

【Claim 4】

The biodegradable starch bowl according to claim 1, wherein the biodegradable starch bowl is a bowl prepared to have a desired shape by heating and pressurizing a composition for the biodegradable starch bowl comprising unmodified starch of 20~60 wt.%, pulp fiber powder of 5~30 wt.%, solvent of 30~60 wt.%, photo catalyst of 0.1~2.0 wt.%, preservative of 0.01~1 wt.% and releasing agent of 0.5~5 wt.%, and a biodegradable film is attached to an inner surface of the bowl.

【Claim 5】

The biodegradable starch bowl according to claim 4, wherein the unmodified starch is one or more selected from a group consisting of corn, potato, wheat, rice, tapioca and sweet potato.

【Claim 6】

The biodegradable starch bowl according to claim 4, wherein the pulp fiber powder has a fiber length of 10 ~ 200 ㎛.

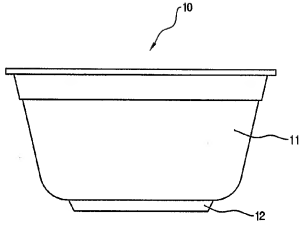
【Claim 7】

Statement under Article 19(1)

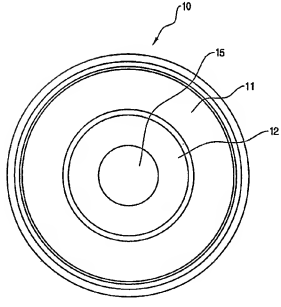
The amendment under PCT Article 19 (1) does not change the technical feature of Claim 1 in that the protrusion on the bottom part of the biodegradable starch bowl is formed for making water, which is evaporated from the biodegradable starch bowl, discharged with ease during cooking in a heating body such as microwave oven. Further, such an amendment is supported by the description of the invention as follows:

『...**To this end, when placing the bowl in a microwave oven and heating it, water can be discharged form the bottom part 120 besides the protrusion 130 and the space 150 in the bottom part of the bowl**...**a space, from which water can be discharged, can be provided. Therefore, an evaporation of water can be induced smoothly and so adhering phenomenon of the bottom part of the bowl can be prevented**...』 (page 9 of the English translation for publication). Therefore, the amendment does not add any new matter but just clarifies the purpose of forming the "protrusion" on the "bottom part" of the "starch" bowl in Claim 1.

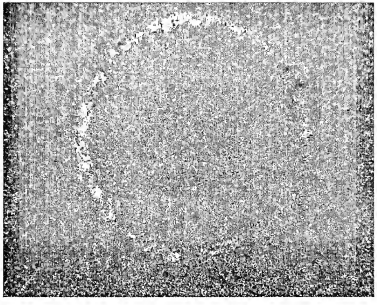
【Fig. 1】



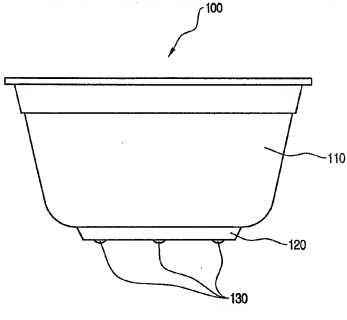
【Fig. 2】



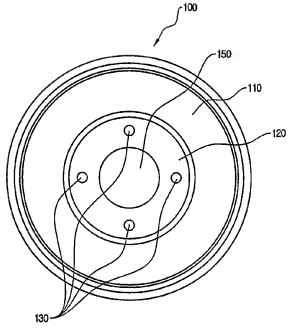
【Fig. 3】



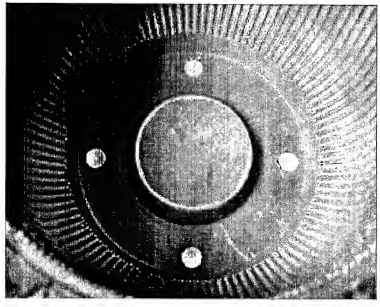
【Fig. 4】



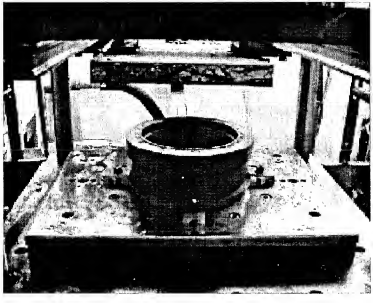
【Fig. 5】



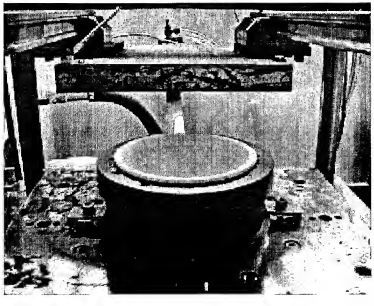
【Fig. 6】



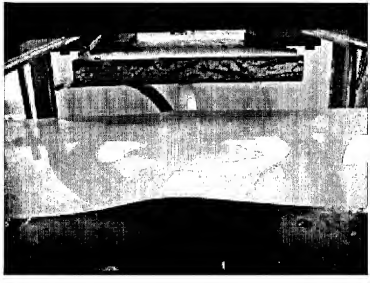
【Fig. 7】



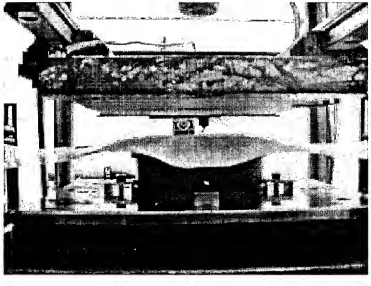
【Fig. 8】



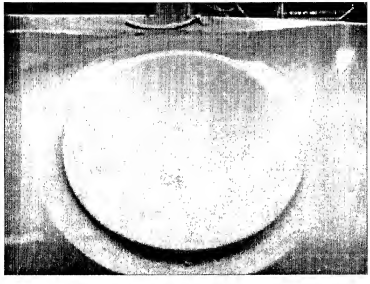
【Fig. 9】



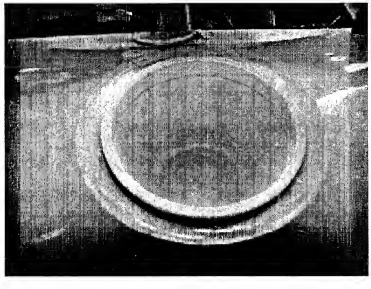
【Fig. 10】



【Fig. 11】

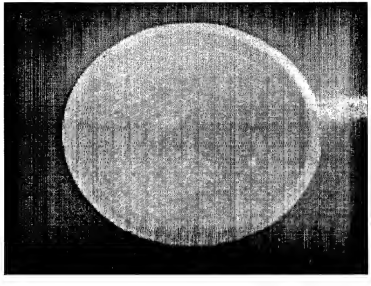


【Fig. 12】

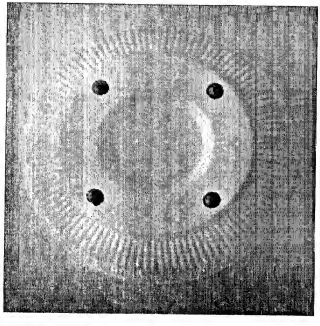


【Fig. 13】

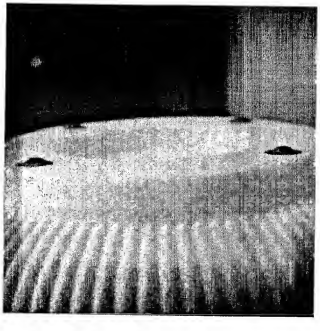
【Fig. 14】



【Fig. 15】

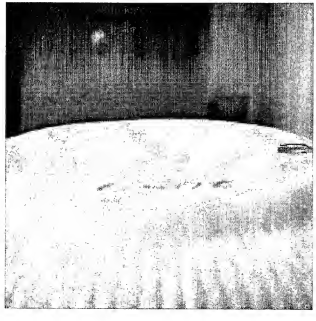


【Fig. 16】

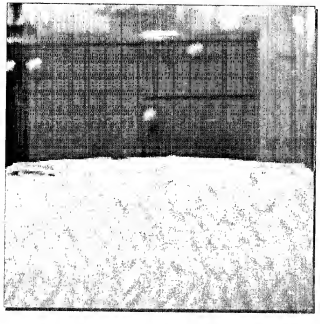


【Fig. 17】

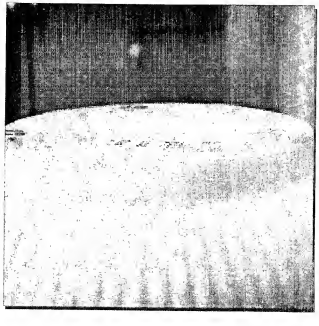
【Fig. 18】



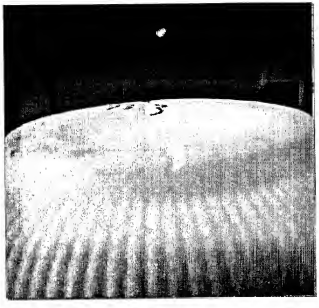
【Fig. 19】



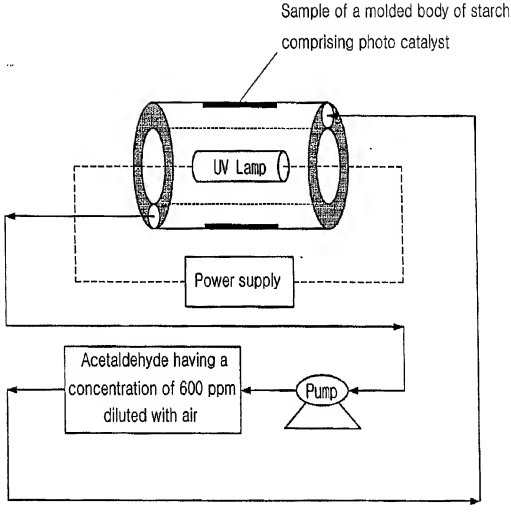
【Fig. 20】



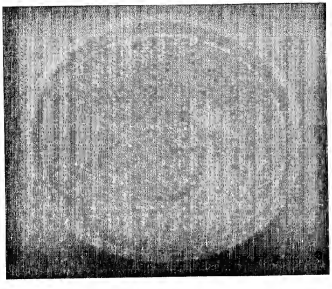
【Fig. 21】



【Fig. 22】

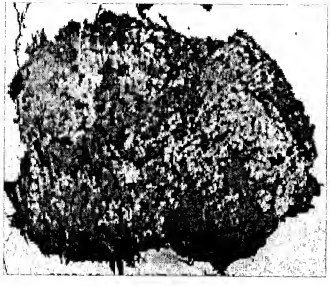


【Fig. 23】

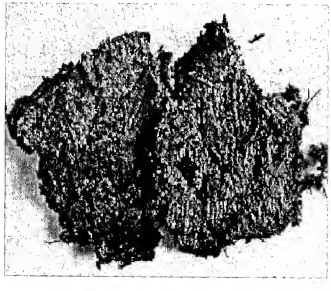


【Fig. 24】

【Fig. 25】



【Fig. 26】



INTERNATIONAL SEARCH REPORT

International application No
PCT/KR2005/002441

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 B65D 65/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65D 65

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Patents and applications for inventions since 1975
Korean Utility models and applictions for Utility models since 1975
Japanese Utility models and application for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
KIPO eKIPASS system

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 53-144874 U (KANNO GYSICHI) 15 November 1978 See Figs. 1-3	1 - 3
Y A	WO 2002/22353 A (NISEI KK) 21 March 2002 See the whole document	1 - 3 4 - 16
Y A	WO 1999/50346 A (AIG ALLG IMMOBILIENVERWALTUNGS, BAAR ANDREAS GERHARD) 07 October 1999 See the whole document	1 - 3 4 - 16

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 OCTOBER 2005 (27.10.2005)	**28 OCTOBER 2005 (28.10.2005)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer CHOI, Ki Hyuk Telephone No. 82-42-481-5894

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2005/002441

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